

1. Module details**Module name****Electronic Hand Soldering Technology****Module duration**

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 - 40 hours.

Module code

NE184.1

Discipline code

0703230

2. Module purpose

This module will provide students with the knowledge and skills to perform soldering tasks on a range of components and connections.

3. Prerequisites

Nil.

4. Relationship to competency standards

This module provides part of the underpinning knowledge and skills in the 'Evidence Guide' of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from NUEITAB.

5. Content**Workshop environment**

Hazards

Facilities

OH&S

Quality control

Reliability

Levels of acceptability

Process control

Cleaning

Contamination: solvent; aqueous; mechanical; thermal

Inspection

Materials and equipment

PCB assembly tools and equipment

Soldering irons

Types

Tips

Maintenance

Ancillary equipment

Solder

Fluxes

Component handling

Electrostatic discharge (ESD)
Effects
Precautions
Electrical overstress (EOS)
Static-free work environment
Static-free component transport

Component mounting – (through hole)

Stress relief
Lead bending
Orientation
Component mounting
Passive
Active
Integrated circuits
Heat dissipation
Lead termination
Fully clinched
Semi clinched
Straight through

Soldering principles

Metallurgical bonding
Wetting
Flux
Heat transfer
Maximum and minimum heat loads
Thermal shock
Mechanical stress
Solder quantity
Filleting, heat bridging and spreading
Plated leads
Alloy degradation

Manual soldering

Cleaning
Tinning
Soldering
Bare copper single-sided board
Solder-plated single-sided board
Solder-plated double-sided printed board
Heat sinking

Introduction to rework philosophy

Reliability
Desoldering
Solder wick
Solder syringes
Vacuum
Component replacement

Inspection

Philosophy
Visual inspection
Defects

Introduction to surface mount technology

SMD packages and identification
Soldering techniques

Cable termination

Wire
PCB
Terminals
Connectors

6. Assessment strategy

Assessment methods

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

Conditions of assessment

Learning and assessment will take place in an environment that is conducive to a learner's development.

7. Learning outcome details

Learning outcome 1

Describe the operation and management of soldering workshop facilities in conformance with current standards of occupational health and safe working practices.

Assessment criteria

- 1.1 Identify potential hazards in soldering workshop environments.
- 1.2 Describe the preparation and maintenance of soldering workshop facilities and ensure current occupational health and safety requirements are met.
- 1.3 Set up and operate a soldering station and ensure current occupational health and safety requirements are met.

Learning outcome 2

Describe the concepts of reliability, quality and process control applicable to the assembly and rework of printed circuit boards.

Assessment criteria

- 2.1 Describe electrical/electronic connection techniques and list their advantages and disadvantages.
- 2.2 Describe standards of reliability and levels of acceptability as determined by current industry standards.
- 2.3 Describe the achievement of zero defects through process and quality control.

Learning outcome 3

Describe the standards of cleanliness for printed circuit boards and use suitable cleaning materials.

Assessment criteria

- 3.1 Describe the requirements for cleanliness and standards of cleanliness for printed board assemblies.
- 3.2 Identify sources of ionic and non-ionic contamination.
- 3.3 Explain the effects of contaminants which cause long term corrosion on printed board assemblies.
- 3.4 Describe the main Printed Circuit Board (PCB) cleaning processes.
- 3.5 Describe typical methods for testing cleanliness.

Learning outcome 4

Describe and use the soldering equipment and materials used in a typical Printed Circuit Board (PCB) repair workshop.

Assessment criteria

- 4.1 Briefly describe the construction of a typical soldering iron and the function of the range of tips available.
- 4.2 Describe the maintenance procedures for soldering irons and tips.
- 4.3 Briefly describe the principles of operation of a typical temperature controlled soldering iron.
- 4.4 Describe the basic properties of solder, including thermal bonding and metallurgical properties.
- 4.5 Briefly describe the composition, properties and function of typical fluxes used in PCB assembly and repair.
- 4.6 Briefly describe the construction and properties of typical PCB laminates.
- 4.7 Briefly describe the types, identification and means of removal of typical conformal coatings used on printed circuit boards.
- 4.8 Demonstrate the correct care, use and maintenance of a variable temperature, electronically controlled soldering station.

Learning outcome 5

Demonstrate appropriate precautions in the handling and use of static sensitive components and describe the materials and techniques available to set up a static free environment.

Assessment criteria

- 5.1 State the effects of Electrostatic Discharge (ESD) and Electrical Overstress (EOS) on static sensitive components.
- 5.2 Describe the materials, equipment and procedures utilised for the control of static electricity in a workshop environment.
- 5.3 Describe the procedures for the safe handling of static sensitive components and assemblies in the workplace.

Learning outcome 6

Demonstrate component mounting techniques, which provide appropriate stress relief and allowance for heat dissipation.

Assessment criteria

- 6.1 Describe the mechanical stresses on a printed circuit board and its components.
- 6.2 For typical electronic components, state the specifications for the bending, mounting and termination of component leads to provide the requisite mechanical stress relief and heat dissipation.
- 6.3 Demonstrate suitable stress relief techniques using wire links and electronic components.

Learning outcome 7

Describe the basic principles and process of soldering.

Assessment criteria

- 7.1 Briefly describe the composition and thermal behaviour of typical soft solders used to solder electrical/electronic components.
- 7.2 Briefly describe the role of “wetting” and “spreading” in the formation of a solder joint.
- 7.3 Briefly describe the metallurgical bonding that occurs during the soldering process.
- 7.4 Describe the role of flux in soldering.
- 7.5 Briefly describe the need for adequate thermal capacity of the soldering iron tip when soldering.
- 7.6 List the appropriate requirements for thermal stability needed when soldering.
- 7.7 Describe the appearance of an ideal solder joint.
- 7.8 Describe the characteristics of an acceptable and unacceptable solder joint

Learning outcome 8

Use soldering tools and equipment to solder a range of typical electronic components to single and double-sided, through hole Printed Circuit Boards (PCBs).

Assessment criteria

- 8.1 Demonstrate appropriate cleaning techniques prior to soldering electronic components to a printed circuit board.
- 8.2 Demonstrate appropriate tinning techniques prior to soldering electronic components to a printed circuit board.
- 8.3 Solder component leads to a single-sided PCB with appropriately formed secondary side fillets.
- 8.4 Solder component leads to a double-sided PCB with appropriately formed primary and secondary side fillets.
- 8.5 Demonstrate the use of appropriate heat-sinking techniques to provide thermal protection for components during soldering.
- 8.6 Describe post-soldering cleaning techniques.

Learning outcome 9	Demonstrate the basic principles of single-sided and double sided Printed Circuit Board (PCB) rework, and cleaning.
Assessment criteria	9.1 Briefly describe the operation of typical desoldering tools. 9.2 Demonstrate typical methods used for the rework of through hole electronic components on a PCB. 9.3 Perform through hole component removal.to the level of acceptability determined by current industry standards.
Learning outcome 10	Carry out the inspection of through hole solder joints.
Assessment criteria	10.1 List common defects in solder joints. 10.2 Identify defective solder joints on a Printed Circuit Board (PCB).
Learning outcome 11	Demonstrate the basic methods used when soldering a limited range of surface mount devices.
Assessment criteria	11.1 Identify the common surface mount device packages, component types and values of a limited range of surface-mount devices. 11.2 Demonstrate the appropriate method used in the installation, inspection and rework of a limited range of SMD's.
Learning outcome 12	Terminate a range of typical electrical/electronic wire and cable to a range of connectors by soldering and mechanical methods.
Assessment criteria	12.1 Demonstrate the correct method(s) of wire preparation and termination to a range of terminals and connectors.

8. Delivery of the module

Delivery strategy

Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require learning outcome sequence other than that indicated in the module.

Resource requirements

Resources should be sufficient for students to carry out practical exercises on an individual basis. This will require:
 Soldering irons (basic and temperature controlled)
 Desoldering tools
 populated and unpopulated PCBs
 leaded and SMD electronic components
 anti-static equipment
 single and multi-strand wire and cable
 ribbon cable
 PWB connectors
 hand tools
 PWB cleaning materials.

Useful references include:

US National Standards: ANSI/J-STD-001: Requirements for Soldered Electrical and Electronic Assemblies.

IPC-A-610: Acceptability of Electronic Assemblies.

US Dept of Defence: MIL-STD-2000: Standard Requirements for Soldered Electrical & Electronic Assemblies – cancelled 1995 but useful as a reference.

NEEITC, Electronic Soldering Techniques, Ambassador Press 1991.

Occupational health and safety requirements

A safe and healthy environment will be provided for students and teachers as well as the particular safety procedures followed as part of the learning / teaching activity and content.